Portable Instrument Protocol

2/19/2004 8:16 PM

RadNet Portable Instrument Protocol
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RadNet Standard Header

2/19/2004 8:16 PM

RadNet Message Header Format

The RadNet header contains the first 55 bytes of all RadNet messages. The header is intended to provide information regarding the operational status and location of an instrument. The header provides information regarding which instruments are (or are not) operating properly.

Field Name	Type	Position	Codes	Notes
Header Check Sum	Byte	1		The first byte (01, byte) is a checksum, to ensure the integrity of the header transmission. The checksum is the sum of bytes 2 through 55.
RadNet Version Number	Byte	2	See RadNet Versions Page	The second byte (02, byte) is the RadNet version number. It is used to indicate the version of the RadNet message. The receiving software is responsible for handling all received RadNet messages, although the most current version's functionality may not be provided.
Message Codes	Byte	3	See RadNet Message Codes Page	Byte (03) is the message code. The message code tells what type of RadNet message has been sent (status, check source, etc.).
Server Address	Word	4-5	None	Bytes (4-5) are the server address (1-64,536) of the pushing device. Since each instrument may perform as its own server, two bytes are used.
Monitor Address	Byte	6	None	Byte (6) is the address (1-256) of a specific monitor hooked up to a server. This protocol is intended to support existing (RS-485) systems. The practicality of hooking up more than 256 monitors to a single RadNet server is questionable.
Server Status	Byte	7	See RadNet Server Status Codes Page	Byte (7) is a code to display the status of the server. Codes are provided for normal as well as a variety of abnormal conditions.
Hardware Status	Byte	8	See Op/Hw Status Page Codes Page	Byte (8) is a code to display the overall Hardware Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions could be attributed to either hardware or operational problems. The instrument vendors are responsible for classifying conditions and prioritizing the status

				change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage, and low background, then the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as a HV power supply failure.
Operational Status	Byte	9	See Op/Hw Status Page Codes Page	Byte (9) is a code to display the overall Operational Status of the instrument. Operational status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument operational problems generally require response by health physics personnel. Other conditions can be attributed to either hardware or operational problems. The instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage, and low background, then the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as a HV power supply failure.
Location	Char[40]	10-49	None	Bytes (10-49) are for the location of the instrument. Location designations are highly individual, so no convention or specification is given. The location label must be left justified. Unused characters must be padded with space charters.
Authentication Byte Count Offset	Word	50-51		The length in bytes of the original message. If non-zero, indicates that authentication is in effect. If zero, then authentication is not implemented See the following web pages for more information: Background Information RadNet Implementation, Authentication, Encryption

RadNet Standard Header

2/19/2004 8:16 PM

Authentication Status	Byte	52	See RadNet Authentication Status Codes Page	"Invalid" flag. This byte is always set to zero when the message is transmitted. Authentication services set this byte to a non-zero value if the message fails signature verification. Clients check this byte with zero meaning valid data and take appropriate "bad data" action if the byte is non-zero. See the following web pages for more information: Background Information RadNet Implementation, Authentication, Encryption
Reserved For Future Use	Byte	53	None	Byte (53) is reserved for future use and must be filled with zero values until specified by the protocol
Monitor Type	Word	54-55	See RadNet Monitor Type Codes Page	Bytes (54-55) are a code for the instrument type.

RadNet Standard Header

2/19/2004 8:16 PM

Portable Instrument Body Format

The Portable Instrument (PI) body message has data conforming to generic Portable Instrument formats and provides real-time PI data. The PI body will tell you what type of portable instrument message you received. The RadNet header contains the first 55 bytes of a RadNet message.

Field Name	Type	Position	Codes	Notes
R1	Float	56-59	N/A	Reserved for Future use
R2	Float	60-63	N/A	Reserved for Future use
Unique ID Preamble	Char [4]	C[1] = 64 C[2] = 65 C[3] = 66 C[4] = 67	N/A	The Unique ID Preamble is used in conjunction with the Unique ID. By combining Unique ID Preamble and the Unique ID we obtain a totally unique ID for the message. This ID is used to connect different PI messages with each other and also allows two-database tables (RadNet messages) to be joined by a foreign key relationship. If another RadNet instrument is combined with a PI, then the PI will use the instrument Unique ID and Preamble ID for its messages. This use will allow the instrument reading and the PI reading to be joined together at the monitoring computer or within a database. When deploying a "smart" PI, it will look for packets from instruments within its area (using server and monitor address, or by IP address). When it sees a RadNet broadcast message, it will capture the Unique ID of the instrument, then it can create a PI message and ship its reading using the captured Unique ID. Another method is to have the instrument look for the PI packets and capture it's Unique ID, then use the PI data for calculation. The instrument can send out the calculated readings onto the network using the PI information and could use its own Preamble ID and the PI's Unique ID. The goal here is to be able to combine the PI data with the instrument data and allow the end user to dictate how it would be implemented. How this is used would be defined by the needs of the end users. The

				PI may handle the task, or instrument on the network, or users may want the monitoring computers to combine the data.
Unique ID	Float	68-71	N/A	Date + Time + any other unique value (e.g., mmddyyhhmmss + monitor address + server address = 1202970812970462). If multiple messages are sent, the Preamble ID+ Unique ID is used to match the multiple messages to one another as the client-monitoring computer receives them. See comments above..
Portable Instrument Message Type	Byte	72	Portable Instrument Message Codes Page	This byte (72) is the PI Message Type Code and is intended to provide information about the type of message being pushed. This information will indicate if there is transactional (or other) data following this byte.

RadNet Standard Header

2/19/2004 8:16 PM

Portable Instrument Status Message

The Portable Instrument (PI) Status Message is used to transmit the status of the instrument while it is collecting/analyzing the data or is in standby mode. Because PI's may be required to be in standby mode (on a shelf or control point) for long periods, the status message can be used to ensure the instrument is still ready for use.

If the "Number of Messages" field is set to 0, then no data will be found past byte 74. However, if "Number of Messages" is set to a value greater then 0, the instrument has sent a ASCII text message that can be displayed or archived. If the message is less than 40 characters long, the instrument will pad the remaining space with space characters (Hex value = 20x or decimal value = 32). If the text is greater than 40 characters then add another status message and increment the Number Of Messages field.

The instrument is still required to set the Operational and Hardware Status codes within the RadNet Header. Upon any status change within the instrument, the instrument shall push a status message and/or Measurement/Spectrum message.

When the instrument has determined a valid analysis result, it shall push the data using the Measurement and Spectrum message format. Then the instrument should resume sending this status message at the normal/abnormal push rates.

The instrument manufacturer is responsible for determining whether to implement the support of text messages, though it is not a requirement of the RadNet protocol. This option may or may not be implemented on all instrumentation.

The instrument manufacturers will define what messages to support and their content. Instrument manufacturers will define how many messages will be combined into 1 RadNet packet. Some instrument manufacturers may combine messages to reduce overhead and network traffic, while others will send only one status message per packet.

See Portable Instrument notes page for an example of the data stream format.

Here is an example of how this could be used:

Packet Number 1	Number Of Messages = 3	Message 0= 'Taking Background Reading' Message 1= 'Stabilizing detector' Message 2= 'Counting Sample'
Packet Number 2	Number Of Messages = 4	Message 0= 'Moving Sample' Message 1= 'Sample Placed' Message 2= 'Stabilizing The Detector' Message 3= 'Counting Sample"'
Packet Number 3	Number Of Messages = 1	Message 0= 'Count Complete, Analyzing Data'
Packet Number 4	Number Of Messages = 4	Message 0= 'Analysis complete' Message 1= 'Shipped Measurement' Message 2= 'Shipped Spectrum' Message 3= 'Standing By..'
Packet Number 5	Number Of Messages = 0	No extra status message sent, instrument using standard RadNet status messages to indicate the current state of the instrument.

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
Number Of Messages	Word	73-74	N/A	Byte (73-74) is the number of repeating messages (frames) that are after this value If Number Of Messages = 0 then the client software should ignore the remaining byte.
Status Message	Char[40]	C[1]=75 C[2]=76 C[3]=77 C[4]=78 C[5]=79 C[6]=80 C[7]=81 C[8]=82 C[9]=83 C[10]=84 C[11]=85 C[12]=86 C[13]=87 C[14]=88 C[15]=89 C[16]=90 C[17]=91 C[18]=92 C[19]=93 C[20]=94 C[21]=95 C[22]=96 C[23]=97 C[24]=98 C[25]=99 C26[]=100 C[27]=101 C[28]=102 C[29]=103 C[30]=104 C[31]=105 C[32]=106 C[33]=107 C[34]=108 C[35]=109 C[36]=110 C[37]=111 C[38]=112 C[39]=113 C[40]=114		If the "Number of Messages" field is set to 0, then no data will be found past byte 74. However, if "Number of Messages" is set to a value greater then 0, then the instrument has sent a ASCII text messages that can be displayed or archived. If the message is less than 40 characters long, then the instrument will pad the remaining space with space characters (Hex value = 20x or decimal value = 32). If the text is greater than 40 characters then add another status message and increment the Number Of Messages field.

Portable Instrument Measurement Footer Format

The Portable Instrument Measurement (PIM) footer message has data conforming to generic PI formats. A RadNet header and Portable Instrument body must precede all footer messages. The header contains the first 55 bytes of a RadNet message; the PI body contains the next 17 bytes, for a total of 72 bytes preceding the footer.

Note: Red Field Names = Repeating Fields

Field Name	Type	Position	Codes	Notes
Instrument Id	Char[16]	73-88	N/A	The Instrument Id is used to indicate the serial number of the instrument or some user Unique Id for this type of instrument. The Instrument ID must be left justified. Unused characters must be padded with space characters. Note: If the external/internal probe and the electronic package are considered one unit, then the unique id at bytes 73-78 would be the same as bytes 212-227 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) then the unique id could be different for bytes 73-78 and 212-227 in the repeating reading frame.
Instrument calibration due day	Byte	89	N/A	Probe/Instrument cal due day, is the day that the Probe/Instrument calibration is past due on. Note: If the external/internal probe and the electronic package are considered one unit (calibrated together as a unit), then the cal due day at byte 89 would be the same as bytes 237 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due day could be different for bytes 89 and

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
				237 in the repeating reading frame.
Instrument calibration due month	Byte	90	N/A	Probe/Instrument cal due month, is the month that the Probe/Instrument calibration is past due on. Note: If the external/internal probe and the electronic package are considered one unit (calibrated together as a unit), then the cal due month at byte 90 would be the same as bytes 238 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due month could be different for bytes 90 and 238 in the repeating reading frame.
Instrument calibration due year	Word	91-92	N/A	Probe/Instrument cal due year, is the year the year that the Probe/Instrument calibration is past due on. This format includes all four digits of the year (1997, etc.) If the external/internal probe and the electronic package are considered one unit (calibrated together as a unit), then the cal due day at byte 91-92 would be the same as bytes 239-240 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due day could be different for bytes 91-92 and 239-240 in the repeating reading frame.
Instrument manufacture code	Byte	93	See Pass Through Instrument Manufacture Code	Byte 93 is used to indicate the manufacture of the instrument, which is transmitting the data.
Number of readings	Word	94-95	N/A	Bytes (94-95) are the number of repeating footer frames that follows byte 95. A zero value will indicate that there is no data in the repeating frame.

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
Reading user Id	Char [16]	96-111..n	N/A	Bytes (96-111..n) are the User ID. The format of this character string is not specified. The User ID must be left justified. Unused characters must be padded with space characters.
Reading RWP	Char [16]	112-127..n	N/A	Bytes (112-127) are for the RWP number. The format of this character string is not specified. The RWP label must be left- justified. Unused characters must be padded with space characters.
Reading other	Char [16]	128-143..n		Bytes (128-143) are for other information. The format of this character string is not specified. The Reading other label must be left justified. Unused characters must be padded with space characters. You can place a text message, bar code number, or RFID tag number within this field. This field maybe using in conjunction with the Reading location to further define the location point.
Reading location	Char [40]	144-183..n		Byte (144-183) is to indicate where the reading was taken. The format of this character string is not specified. The Reading location label must be left justified. Unused characters must be padded with space characters. You can place a test message, bar code

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
				location, or RFID tag number within this field. These fields maybe used in conjunction with the Reading location to further define the location point.
Reading job type	Word	184-185..n	See Portable Instrument Job Codes	Bytes 184-195 are used to indicate what type of reading is being taken. See Portable Reading Job Types for more information.
Reading day	Byte	186..n		Byte 186 indicates the day (23) the reading was taken. Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.
Reading month	Byte	187..n		Byte 187 indicates the month (11) the reading was taken. Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.
Reading year	Word	188-189..n		Byte 188-189 indicates the year the reading was taken. This format includes all four digits of the year (1997, etc.) Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.
Reading hour	Byte	190..n		Byte 190 indicates the hour (23) the reading was taken. Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.
Reading minute	Byte	191..n		Byte 191 indicates the minute (33) the reading was taken. Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
Reading seconds	Byte	192..n		Byte 192 indicates the seconds the readings was taken. Note: Not all instruments have a real time clock. If the instrument does not support this feature, then the value will be set to 0.
Channel number	Byte	193..n		Byte 193 indicates the channel number that the reading was taken with. If an instrument has three channels, then the valid values would be 0-2. Note: Not all instrument instruments support multiple channels. If the instrument does not support this feature, then the value will be set to 0.
Reading	Float	194-197..n		Byte 194-197 indicates the current reading.
Background Reading	Float	198-201..n		Byte 198-201 indicates the current background level. The background readings are in the same units as bytes 198-201. See Bytes 219 for RadNet units. Note: Not all instrument support background subtraction. If the instrument does not support this feature, then the value will be set to 0.
Reading Id	Char [16]	202-217..n		The Probe/Instrument Id is used to indicate the serial number of the instrument or some user Unique Id for this type of instrument/probe. The Instrument ID must be left justified. Unused characters must be padded with space characters. Note: If the external/internal probe and the electronic package were considered as one unit, then the unique id at bytes 73-78 would be the same as bytes 202-217 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) then

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
				the unique id could be different for bytes 73-78 and 202-217 in the repeating reading frame.
Reading type	Byte	218..n	See Portable Instrument Reading Codes	This field indicates if the reading has been correct for any reason. A net reading is a gross reading that has been corrected/adjusted. It is the responsibility of the instrument manufacture to specify the corrections applied to the gross reading. Such as: background subtraction (fixed or variable), crossover correction, temperature-based corrections, etc. A Gross reading is the results when the instrument does not perform any corrections. A Net reading is the results when the instrument does perform a correction. It responsibility of the manufacture to determine/document what constitutes a net reading If the instrument does not support this option, then this value will be set to 0 (N/A or Not Supported)
Units	Byte	219..n	See RadNet Units Page	Byte 219 is the units for the reading being sent.
Measurement mode	Byte	220..n	See Portable Instrument Measurement Mode Codes	Byte 220 is the type of measure mode that the reading was taken with. If the instrument was in a ratemeter mode, then the value = 1 or if the instrument was in integrate mode then the value would equal 2. If the instrument does not support this option, then this value will be set to 0 (N/A or Not Supported)
Type codes	Word	221-222.n	See Portable Instrument Probe Type Codes	Byte 221-222 is used to indicate the type of probe/instrument used to take the reading. If a Gas Filled, energy proportional

Field Name	Type	Position	Codes	Notes
				instrument was used, then the value = 1. If the instrument does not support this option, then this value will be set to 0 (N/A or Not Supported)
Channel type	Byte	223..n	See Channel Types Page	Byte 223 is used to indicate the channel type that was used to take the reading. If the Alpha channel were used, then the value would be set to 0 or if the gamma channel were used then the value would be 2.
Slide position	Byte	224..n	See Portable Instrument Slide Position Codes	Byte 224 is used to indicate that a slide position or some other device has been removed to detect more/other events. Such as an ion chamber, when the beta shield is removed, then the detector will allow beta particles to enter the counting chamber. If the instrument does not support this option, then this value will be set to 0 (N/A or Not Supported)
Calibration due day	Byte	225..n		Probe/Instrument cal due day, is the day the Probe/Instrument calibration is past due on. Note: If the external/internal probe and the electronic package were considered one unit (calibrated together as a unit), then the cal due day at byte 89 would be the same as bytes 225 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due day could be different for bytes 89 and 225 in the repeating reading frame.
Calibration due month	Byte	226..n		Probe/Instrument cal due month, is the month the Probe/Instrument

Field Name	Type	Position	Codes	Notes
				calibration is past due on. Note: If the external/internal probe and the electronic package were considered one unit (calibrated together as a unit), then the cal due month at byte 90 would be the same as bytes 226 in the repeating reading frame. If multiple corrections are made, then the following method will be used. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due month could be different for bytes 90 and 226 in the repeating reading frame.
Calibration due year	Word	227-228..n		Probe/Instrument cal due year, is the year the Probe/Instrument calibration is past due on. This format includes all four digits of the year (1997, etc. If the external/internal probe and the electronic package are considered one unit (calibrated together as a unit), then the cal due day at byte 91-92 would be the same as bytes 227-228 in the repeating reading frame. If the probe and the electronic package are considered separate items (not contained within the instrument) and not calibrated as unit, then the cal due day could be different for bytes 91-92 and 227-228 in the repeating reading frame.
Detector surface area	Word	229-230..n		Byte 229-230 is used to indicate the total probe surface area. This field can also be used to indicate the volume of ion chamber or tritium or set to 0. Units = cm2
Hardware Status	Byte	231..n	See Op/Hw Status Page	Byte (231) is a code to display the reading Hardware Status of the

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
				instrument. The purpose of the field is used to indicate the instrument hardware status when the reading was taken. See RadNet header Hardware Status for more information.
Operational Status	Byte	232..n	See Op/Hw Status Page	Byte (232) is a code to display the reading Operational Status of the instrument. The purpose of the field is used to indicate the instrument operational status when the reading was taken. See RadNet header Operational Status for more information.
Comments	Char[40]	233-272..n		Byte 233-272 is used to provide a means to add comments for the reading taken by the instrument
Number Of Channels	Byte	273..n		Byte 273 is used to indicate how many repeating frames precede byte 273. If byte 273 is set to zero then no data will follow this field. The following data frame is intended to provide portable instrument to supply data outside the normal scope of standard portable instrument. For example: The instrument may contain a temperature sensor. If the instrument is operated out side of specified range or subject to a temperature shock, would be able to indicate this data using this repeating frame. If the instrument does not support this option, then this value will be set to 0 (N/A or Not Supported)
Channel Number	Byte	274..n		Byte 274 is the Channel Number presented in the frame. It can be used as the detector number or any reference to a portable instrument channel. Although not strictly required, since the frame length and number of frames

RadNet Standard Header

2/19/2004 8:16 PM

Field Name	Type	Position	Codes	Notes
				are known, having the channel number in the frame can assist when troubleshooting.
Channel Type	Byte	275..n	See Channel Types Page	Byte 275 is a code for the Channel Type.
Channel Hardware Status	Byte	276..n	See Op/Hw Status Page	Byte 276 is a code for the Channel Hardware Status.
Channel Operational Status	Byte	277..n	See Op/Hw Status Page	Byte 277 is a code for the Channel Operational Status.
Reading	Float	278-281..n		Byte 278-281 is the Reading for the channel.
Units	Byte	282..n	See RadNet Units Page	Byte 282 is a code for the units of the reading.
Comments	Char[16]	283-298..n		Byte 283-298 is used to provide comments for the channel data.

Portable Instrument Spectrum Footer

The Portable Instrument Spectrum footer message has data conforming to generic Portable Instrument (PI) formats. A RadNet header and body must precede all footer messages. The header contains the first 55 bytes of a RadNet message; the PI body contains the next 13 bytes, for a total of 72 bytes preceding the footer.

The instrument shall ship raw Spectrum data only. Massaging of the spectrum data by the instrument is not allowed when using the RadNet protocol. This limit allows client/monitoring software to perform its own analysis.

See Portable Instrument Examples for an example of the data stream format.

Note: Red Field Names = Repeating Fields

Field Name	Type	Position	Codes	Notes
Segment ID	Byte	73		Segment ID is the sequential identification number of segment that is being pushed. (e.g., Segment ID = 2 (2 OF 3) Number Of Segments = 3)
Number Of Segments	Byte	74		The number of segments is the total number of RadNet spectrum messages being pushed. If the Number Of Channels is > 512 channels then the GWM must ship the spectrum message in multiple messages.
Live Time	Float	75-78		The amount of time, during measurement, that the spectrometer is able to reliably resolve separate events in time. Live time is essentially the opposite of dead time. Dead time refers to the time that the nuclear-pulse electronics are busy processing one pulse and therefore cannot accept another. There are many methods (electronics, feedback) to correct for dead-time loss and beyond the scope of this discussion. Gamma-ray spectrometers are equipped with feedback electronics to track and correct for system dead time, reporting detector live time and real time during a measurement. Note: In connection with each spectrum analysis, it is critically important to account for live time in radionuclide quantification.
Real Time	Float	79-82		Clock time. The actual time period for the

				duration of a measurement. Real time is always less than live time. As count rate increases, real time becomes a smaller fraction of live time. Gamma-ray spectrometers are equipped with an internal clock to track and report real time.
Energy Calibration Offset	Float	83-86		It is necessary to establish a relationship between the channel of the ADC and the energy of the incoming photon in order to establish the radionuclide. This relationship is mostly linear, but to accommodate minor non-linearities, the ADC is calibrated to energy using the following second-order relationship: $E = \beta_0 + \beta_1 C + \beta_2 C^2$ Where E is photon energy, C is Channel of the ADC, and β_0, β_1, β_2 are calibration fit coefficients from a least-squares fit of the calibration data. β_0 is the calibration offset, the value of E on a calibration graph of C versus E, corresponding to channel zero (C=0). Note: In connection with each spectrum analysis, the energy calibration slope (β_0)and offset (β_1) terms are used to determine the channels that are used to perform the analysis of the spectrum. The analysis regions are determined in units of energy, not in units of channels, and hence stay the same. The energy calibration information can also be used to display the spectrum with an energy x-axis. Units = keV
Energy Calibration Slope	Float	87-90		Energy Calibration Slope, β_1 in the equation above, is used to reproduce the spectrum as a function of Energy (rather than Channel). The slope coefficient is determined through calibration, using a radionuclide of known gamma-ray energies, creating a table of energy versus channel, and performing a least-squares fit to the data.

Energy Calibration 2nd Order Term	Float	91-93		During the least-squares fit process associated with the calibration for energy, it is possible, though not likely, that a second-order non-linearity be introduced into relationship. Normally, the coefficient, β_2, is zero. In the event that the calibration is not statistically linear, this coefficient provides an estimate for the degree of nonlinearity.
Start Channel Number	Word	94-95		The Start Channel number is the starting channel number of the spectrum within this message, such as: Number Of Segments = 2 Segment ID = 1 Start Channel = 1 Stop Channel = 512 Number Of Channels = 512 Segment ID = 2 Start Channel = 513 Stop Channel = 1024 Number Of Channels = 512
Stop Channel Number	Word	96-97		The Stop Channel number is the ending channel number of the spectrum within this message. For example: Number Of Segments = 2 Segment ID = 1 Start Channel = 1 Stop Channel = 512 Number Of Channels = 512 Segment ID = 2 Start Channel = 513 Stop Channel = 1024 Number Of Channels = 512
Number Of Isotope Labels (NOIL)	Byte	98		NOIL is the Number Of repeating Isotope Labels (IL) contained within this message. If the GWM does not support this field, then 0 (zero) should be entered. **If the NOILs contains a 0 (zero) then the next 6 fields will be omitted and byte 99 will be the scaling factor.**
Isotope Label Start Energy (IL)	*Float*	[(99+81x)-(102+81x)]		*The Analysis Region Start Energy is the beginning energy for this IL(n) region.*

				Units = keV
Isotope Label Stop Energy (IL)	*Float*	[(103+81x)-(106+81x)]		*The Analysis Region Stop Energy is the ending energy for this IL(n) region.* *Units = keV*
Label	*Char[16]*	[(107+81x)-(122+81x)]		*The Label is the isotope label for this IL(n) or any other descriptor i.e. PU-239, U-235, Mixed, Mecial, etc.* *If the Label is <16 characters, then the unused bytes must be padded with space characters (ASCII Decimal 32)*
Reliability Index (confidence Index)	*Byte*	[(123+81x)-(123+81x)]	See Reliability Index Codes	*This Values is used to support draft ANSI Standard N42.34*
Comment(s)	*Char[40]*	[(124+81x)-(163+81x)]		*This value is used to hold comments concerning each IL. It can also be used to support ANSI Standard N42.34.* *Such as:* *Caution – SNM could be masked, Caution – interferences detected with signal, and so on.*
Reserved For Future Use	*8 Bytes*	[(164+81x)-(171+81x)]		*This is reserved space for future use.*
Scaling Factor	Float	[(172+24x)-(175+24x)]		Use this value to scale the largest reading to fit into the reading field, when the maximum number of counts/events > 64K. Client Software must take the reading multiplied by the scaling factor to obtain the actual results. e.g. For a reading of 88,480, the scaling factor would be 2.765 and the channel reading would be 32000 (32000 * 2.765 = 88480))
Number Of Channels (y)	Word	(176+24x)-(177+24x)]		The Number Of Channels is the number of readings/channels that will be presented as repeating frames.
Reading	*Word*	(((178+(24x))+2)+2y)) - (((179+24x))+2)+(2y))..n		*Reading is the counts/events for each channel.*

Portable Instrument Spectrum Measurement Footer

The Portable Instrument (PI) Spectrum Measurement footer message has data conforming to generic PI formats and used in conjunction with the PI Spectrum Footer. A RadNet header and body must precede all footer messages. The header contains the first 55 bytes of a RadNet message; the PI body contains the next 13 bytes, for a total of 72 bytes preceding the footer

Note: Red Field Names = Repeating Frames/Fields
Note:..n indicates a repeating frame of data

Field Name	Type	Position	Codes	Notes
Segment ID	Byte	73	N/A	Segment ID is the sequential identification number of the segment that is being pushed. i.e.. Segment Id = 2 (2 OF n) Number Of Segments = 3
Number Of Segments	Byte	74	N/A	The number of segments is the total number of RadNet Spectrum footers being pushed. If the spectrum is > 512 channels, then the instrument must ship the spectrum in multiple messages.
Live Time	Float	75-78	N/A	The amount of time, during measurement, that the spectrometer is able to reliably resolve separate events in time. Live time is essentially the opposite of dead time. Dead time refers to the time that the nuclear-pulse electronics are busy processing one pulse and therefore cannot accept another. There are many methods (electronics, feedback) to correct for dead-time loss and beyond the scope of this discussion. Gamma-ray spectrometers are equipped with feedback electronics to track and correct for system dead time, reporting detector live time and real time during a measurement. Note: In connection with each spectrum analysis, it is critically important to account for live time in radionuclide quantification.
Real Time	Float	79-82	N/A	Clock time. The actual time period for the duration of a measurement. Real time is always less than live time. As count rate increases, real time becomes

				a smaller fraction of live time. Gamma-ray spectrometers are equipped with an internal clock to track and report real time.
Calibration Month	Byte	83	N/A	Byte (83) is the month of the year
Calibration Day	Byte	84	N/A	Byte (84) is the day of the month
Calibration Year	Word	85-86	N/A	Bytes (85-86) are the year. This is all four digits of the year (1997, etc.)
Calibration Reference/Id	Char [20]	C[1]=87 C[2]=88 C[3]=89 C[4]=90 C[5]=91 C[6]=92 C[7]=93 C[8]=94 C[9]=95 C[10]=96 C[11]=97 C[12]=98 C[13]=99 C[14]=100 C[15]=101 C[16]=102 C[17]=103 C[18]=104 C[19]=105 C[20]=106	N/A	Used to reference the sample results to the calibration of the instrument The format of this character string is not specified. The Calibration Reference label must be left-justified. Unused characters must be padded with space characters.
Geometry Reference/Id	Char [20]	C[1]=107 C[2]=108 C[3]=109 C[4]=110 C[5]=111 C[6]=112 C[7]=113 C[8]=114 C[9]=115 C[10]=116 C[11]=117 C[12]=118 C[13]=119 C[14]=120 C[15]=121 C[16]=122 C[17]=123 C[18]=124 C[19]=125 C[20]=126		Used to reference the counting geometry for the sample data. The format of this character string is not specified. The Geometry Reference label must be left justified. Unused characters must be padded with space characters.
Isotope Library Reference/Id	Char [20]	C[1]=127 C[2]=128	N/A	Used to reference the Isotopic Library that was used to obtain the sample results.

		C[3]=129 C[4]=130 C[5]=131 C[6]=132 C[7]=133 C[8]=134 C[9]=135 C[10]=136 C[11]=137 C[12]=138 C[13]=139 C[14]=140 C[15]=141 C[16]=142 C[17]=143 C[18]=144 C[19]=145 C[20]=146		The format of this character string is not specified. The Isotope Library Reference label must be left justified. Unused characters must be padded with space characters.
Instrument Serial Number/Id	Char[20]	C[1]=147 C[2]=148 C[3]=149 C[4]=150 C[5]=151 C[6]=152 C[7]=153 C[8]=154 C[9]=155 C[10]=156 C[11]=157 C[12]=158 C[13]=159 C[14]=160 C[15]=161 C[16]=162 C[17]=163 C[18]=164 C[19]=165 C[20]=166	N/A	
Number Of Measurement	Word	167-168	N/A	Byte (167-168) is the number of repeating frames that are contained after this value
Isotope	Char [16]	C[1]=169..n C[2]= 170..n C[3]= 171..n C[4]= 172..n C[5]= 173..n C[6]= 174..n C[7]= 175..n C[8]= 176..n C[9]= 177..n C[10]= 178..n C[11]= 179..n C[12]= 180..n	N/A	Isotope is the primary isotope(s) associated with this measurement. i.e. PU-239, U-239, Background, Radon, Medical, etc.

		C[13]= 181..n C[14]= 182..n C[15]= 183..n C[16]= 184..n		
Reading	Float	185-188..n	N/A	The calculated result for the Isotope.
Units	Byte	189..n	See RadNet Units Page	If the Isotope = CS-137, reading= 1.2, and the units set to 21 then the measurement would be 1.2 bq/m3 for CS-137.
Reading Percent Error	Float	190-193..n	N/A	Reading Percent Error is the error associated with the units above and is defined by the instrument manufacture. A common practice is to report percent relative standard deviation, which is the standard deviation divided by the mean value. Units = see unit above
Detectability Limit	Float	194-197..n	N/A	The Lower Limit of Detection (LLD) is defined by the instrument manufacture. It has been interchangeably used with the term Minimum Detectable Activity (MDA). In either definition, the field name “Detectability limit” passes this value, for the given radionuclide activity. Units = see units above
Reserved For Future Use	Byte [40]	198-237..n	N/A	Reserved for Future use.

Note:..n indicates a repeating frame of data

Portable Instrument Notes/Comments

Portable Instrument Message = 0 then see Portable Instrument Measurement Footer Page. The Portable Instrument Measurement Footer is pushed whenever there are any status changes or an abnormal push frequency. This footer is optional and is not needed if no additional channel data is supplied.

If Portable Instrument Message = 1 then see Portable Instrument Spectrum Footer Page. This setting should be instrument configurable (Turn on/off RadNet spectrum shipping). When spectrum shipping is turned on, the Portable Instrument Spectrum Footer should be pushed after the measurement has been pushed whenever the monitor is alarmed. The monitor should always ship the measurement prior to shipping the spectrum.

If Portable Instrument Message = 2 then see Portable Instrument Spectrum Measurement Footer Page. The Portable Instrument Spectrum Measurement Footer whenever the monitor is alarmed or once a status change has occurred. The monitor should always ship the measurement prior to shipping the spectrum data.

If Portable Instrument Message = 3 then see Portable Instrument Status Message Footer Page. This setting should be instrument configurable (turn on/off RadNet Status shipping). When status shipping is turned on, the Portable Instrument Status Footer is shipped whenever the instrument is ideal or no status change has occurred with the instrument. When the

instrument has valid data or upon a status change, it will push data using the Measurement, or Spectrum, /Spectrum Measurement format and can be used in conjunction with any other the other RadNet Portable Instrument messages to inform the user of text messages. This message is not intend to be the only message being shipped by the instrument.

Example of Portable Instrument Status Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
Portable Instrument Body	56	72	
Start Of Status Message Footer			
Number of Messages	73	73	Number of Messages=4
Start Of Messages Repeating Frame Data			
Status Message 0	74	113	Status Message 0 Value= 'Moving Sample'
End of Status Message 1 Data			
Status Message 1	74	113	Status Message 1 Value = 'Sample Placed'
End of Status Message 1 Data			
Status Message 2	74	113	Status Message 2 Value= 'Stabilizing The Detector'
End of Status Message 1 Data			
Status Message 3	74	113	Status Message 3 Value = 'Counting Sample'
End of Status Message 1 Data			
End Of Messages Repeating Frame Data			
End Of Status Message Footer			

RadNet Standard Header

2/19/2004 8:16 PM

Example of Portable Instrument (PI) Spectrum Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
PI Body	56	72	
Start Of Spectrum Message Footer			
Segment ID	73	73	
Number Of Segments	74	74	
Live Time	75	78	
Real Time	79	82	
Energy Calibration Offset	83	86	
Energy Calibration Slope	87	90	
Energy Calibration 2nd Order Term	91	93	
Start Channel Number	94	95	
Stop Channel Number	96	97	
Number Of Isotope Labels (NOIL)	98	98	Number NOIL Value = 4
Start Of IL Repeating Frame Data			
Isotope Label (IL) Number 0			
IL Start Energy	99	102	Value = 700
IL Stop Energy	103	106	Value = 800
IL Label	107	122	Value =”Co-60**********” * = ASCII Code 32
IL Reliability Index	123	123	Value = 0
IL Comments(s)	124	163	Value = “Caution – SNM could be masked**********” * = ASCII Code 32
IL Reserved For Future Use	164	171	Value = 0
End of IL 1 Data			

Isotope Label (IL) Number 1			
IL Start Energy	172	175	Value = 1200
IL Stop Energy	176	179	Value = 1240
IL Label	180	195	Value =”Co-59*********” * = ASCII Code 32
IL Reliability Index	196	196	Value = 0
IL Comments(s)	197	236	Value = “Caution – SNM could be masked**********” * = ASCII Code 32
IL Reserved For Future Use	237	244	Value = 0
End of IL 2 Data			
Isotope Label (IL) Number 2			
IL Start Energy	245	248	Value = 1250
IL Stop Energy	249	252	Value = 1279
IL Label	253	268	Value =”Cs-137********” * = ASCII Code 32
IL Reliability Index	269	269	Value = 0
IL Comments(s)	270	309	Value = “Caution – SNM could be masked**********” * = ASCII Code 32
IL Reserved For Future Use	310	317	Value = 0
End Of IL 3 Data			
Isotope Label (IL) Number 3			
IL Start Energy	318	321	Value = 1300
IL Stop Energy	322	325	Value = 1310
IL Label	326	341	Value =”Cs-137********” * = ASCII Code 32
IL Reliability Index	342	342	Value = 0
IL Comments(s)	343	382	Value = “Caution – SNM could be masked**********” * = ASCII Code 32
IL Reserved For Future Use	383	390	Value = 0
End Of IL 4 Data			

RadNet Standard Header

2/19/2004 8:16 PM

End of IL Repeating Frame Data			
Scaling factor	391	394	Value = 2.364598
Number of Channels	395	396	Number Of Channels Value = 11
Start of Number Channels Repeating Frames			
C0	397	398	
C1	399	400	
C2	401	402	
C3	403	404	
C4	405	406	
C5	407	408	
C6	409	410	
C7	411	412	
C8	413	414	
C9	415	416	
C10	417	418	
End of Number Channels Repeating Frames			

End Of Spectrum Message Footer

RadNet Standard Header

2/19/2004 8:16 PM

Example of Portable Instrument (PI) Spectrum Measurement Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
PI Body	56	72	See example above
Start Of Spectrum Message Footer			
Segment Id	73	73	Value = 1
Number of Segments	74	74	Value = 1 (1 of 1)
Live Time	75	78	Value = 30
Real Time	79	82	Value = 30
Calibration Month	83	83	Value = 1
Calibration Day	84	84	Value = 22
Calibration Year	85	86	Value = 2003
Calibration Reference Id	87	106	Value = "L1-2394-489-233*****" * = ASCII Code 32
Geometry Reference Id	107	126	Value = "L1-2394-489-233*****" * = ASCII Code 32
Isotope Library Reference Id	127	146	Value = "L1-2394-489-233*****" * = ASCII Code 32
Instrument Serial Number	147	166	Value = "12345-49589384984***" * = ASCII Code 32
Number Of Measurements	167	168	Value = 4
Start of Number Of Measurement Repeating Frames			
Isotope	169	184	"
Reading	185	188	
Units	189	189	
Reading Percent Error	190	193	

Detectability Limit	194	197	
Reserved For Future Use	198	237	
End Of Measurement 0 Data			
Isotope	238	253	
Reading	254	257	
Units	258	258	
Reading Percent Error	259	262	
Detectability Limit	263	266	
Reserved For Future Use	267	306	
End Of Measurement 1 Data			
Isotope	307	322	
Reading	323	326	
Units	327	327	
Reading Percent Error	328	331	
Detectability Limit	332	335	
Reserved For Future Use	336	375	
End Of Measurement 2 Data			
Isotope	376	391	
Reading	392	395	
Units	396	396	
Reading Percent Error	397	400	
Detectability Limit	401	404	
Reserved For Future Use	405	444	
End Of Measurement 3 Data			
End of Number of Measurement Repeating Frames			
End Of Measurement Message Footer			

RadNet Standard Header

2/19/2004 8:16 PM

RadNet Standard Header

2/19/2004 8:16 PM

Example of Portable Instrument Measurement Message Format:

RadNet Field	Start Byte Position	End Byte Position	Notes
RadNet Header	1	55	
Start Of PI Body			
Reserved For Future Use	56	63	
Unique Id Preamble	64	67	Value=Aqe%
Unique Id	68	71	Value = 120302152115678
Portable Instrument Message Type	72	72	Value = 0
End Of PI Body			
Start Of PI Measurement Message Footer			
Instrument Id	73	88	Value = “124356**********” * = ASCII Code 32
Calibration Due Day	89	89	Value = 3
Calibration Due Month	90	90	Value = 12
Calibration Due Year	91	92	Value = 2003
Instrument Manufacture Code	93	93	Value = 3
Number Of Readings	94	95	Value = 3
Start Of PI Repeating Measurement Frames			
Reading User Id	96	112	Value =”12345678********” * = ASCII Code 32

Reading RWP	113	128	Value =”123-456-789*****” * = ASCII Code 32
Reading Other	139	144	Value =”Top Of Glove box*” * = ASCII Code 32
Reading Location	145	184	Value =”RM-1234565******” * = ASCII Code 32
Reading Job Type	185	186	Value =1, Routine Survey
Reading Day	187	187	Value =7
Reading Month	188	188	Value =11
Reading Year	189	190	Value =2003
Reading Hour	191	191	Value =12
Reading Minute	192	192	Value =23
Reading Seconds	193	193	Value =34
Channel Number	194	194	Value =1
Reading	195	198	Value =12.3764
Background Reading	199	202	Value =0
Probe/Instrument Id	203	218	Value = “124356**********” * = ASCII Code 32
Probe/Instrument Reading Type	219	219	Value =1, Gross
Reading Units	220	220	Value =1 Rem/Hr
Measurement Mode	221	221	Value =1, Ratemeter
Probe/Instrument Type Codes	222	223	Value =5, Gas Filled, Energy Proportional
Reading Channel Type	224	224	Value =3, Neutron
Slide Position	225	225	Value =0, N/A
Calibration Due Day	226	226	Value =3
Calibration Due Month	227	227	Value =3
Calibration Due Year	228	229	Value =2004
Detector Surface Area	230	231	Value =0, NA
Hardware Status	232	232	Value =0, Normal
Op Status	233	233	Value =0, Normal
Comments	224	273	Value = HEPA Filter 117-1837**********

			**********”
End Of PI Repeating Reading Measurement Frame 0			
Reading User Id	274	289	Value =”123456**********” * = ASCII Code 32
Reading RWP	290	305	Value =”123-456-789*****” * = ASCII Code 32
Reading Other	306	321	Value =”1234-39847-9877*” * = ASCII Code 32
Reading Location	337	337	Value =”RM-12345********” * = ASCII Code 32
Reading Job Type	338	339	Value =1, Routine Survey
Reading Day	340	340	Value =7
Reading Month	341	341	Value =11
Reading Year	342	343	Value =2003
Reading Hour	344	344	Value =12
Reading Minute	345	345	Value =23
Reading Seconds	346	346	Value =34
Channel Number	347	347	Value =1
Reading	348	351	Value =1234.3764
Background Reading	352	355	Value =0
Probe/Instrument Id	356	371	Value = “124356**********” * = ASCII Code 32
Probe/Instrument Reading Type	372	372	Value =1, Gross
Reading Units	373	373	Value =1 Rem/Hr
Measurement Mode	374	374	Value =1, Ratemeter
Probe/Instrument Type Codes	375	376	Value =5, Gas Filled, Energy Proportional
Reading Channel Type	377	377	Value =3, Neutron
Slide Position	378	378	Value =0, N/A
Calibration Due Day	379	379	Value =3
Calibration Due Month	380	380	Value =3

Calibration Due Year	381	382	Value =2004
Detector Surface Area	383	384	Value =0, NA
Hardware Status	385	385	Value =0, Normal
Op Status	386	386	Value =0, Normal
Comments	387	426	Value = “Waste Box********** ********** ” * = ASCII Code 32
End Of PI Repeating Reading Measurement Frame 1			
Reading User Id	427	442	Value =”12345678********” * = ASCII Code 32
Reading RWP	443	458	Value =”123-456-789*****” * = ASCII Code 32
Reading Other	459	474	Value =”Left Side GB****” * = ASCII Code 32
Reading Location	475	490	Value =”RM-12345********” * = ASCII Code 32
Reading Job Type	491	492	Value =1, Routine Survey
Reading Day	493	493	Value =7
Reading Month	494	494	Value =11
Reading Year	495	496	Value =2003
Reading Hour	497	497	Value =12
Reading Minute	498	498	Value =23
Reading Seconds	499	499	Value =34
Channel Number	500	500	Value =1
Reading	501	504	Value =1234.3764
Background Reading	505	508	Value =0
Probe/Instrument Id	509	524	Value = “124356**********” * = ASCII Code 32
Probe/Instrument Reading Type	525	525	Value =1, Gross
Reading Units	526	526	Value =1 Rem/Hr
Measurement Mode	527	527	Value =1, Ratemeter

Probe/Instrument Type Codes	528	528	Value =5, Gas Filled, Energy Proportional
Reading Channel Type	530	530	Value =3, Neutron
Slide Position	531	531	Value =0, N/A
Calibration Due Day	532	532	Value =3
Calibration Due Month	533	533	Value =3
Calibration Due Year	534	534	Value =2004
Detector Surface Area	536	536	Value =0, NA
Hardware Status	538	538	Value =0, Normal
Op Status	539	539	Value =0, Normal
Comments	540	579	Value = HEPA Filter 118-1837********** **********”
End Of PI Repeating Measurement Frame 2			
Number Of Channels	580	581	Number Of Channels Values = 4
Start of Number Channels Repeating Frames			
Channel Number	582	582	Value = 1
Channel Type	583	583	Value = 9
Hardware Status	584	584	Value = 0
Op Status	585	585	Value = 0
Reading	586	589	Value = 23
Units	590	590	Value = 6
Comments	591	606	Value = “Instrument Temp”
End Of Channel 0 Data			
Channel Number	607	607	Value = 2
Channel Type	608	608	Value = 17
Hardware Status	609	609	Value = 0

Op Status	700	700	Value = 0
Reading	701	704	Value = 70
Units	705	705	Value =35
Comments	706	722	Value = “none”
End Of Channel 1 Data			
Channel Number	723	723	Value =3
Channel Type	724	724	Value =3
Hardware Status	725	725	Value = 0
Op Status	726	726	Value = 0
Reading	727	730	Value =12.45
Units	731	731	Value =1
Comments	723	747	Value =”none”
End Of Channel 2 Data			
Channel Number	748	748	Value =3
Channel Type	749	749	Value =3
Hardware Status	750	750	Value = 0
Op Status	751	751	Value = 0
Reading	752	755	Value =2.45
Units	756	756	Value =1
Comments	757	772	Value =”Average Bkg”
End Of Channel 3 Data			
End of Number Channels Repeating Frames			
End Of Measurement Message Footer			

Portable Instrument Specific Codes

Portable Instrument Protocol

2/19/2004 8:16 PM

Portable Instrument Reading Job Type Codes

Portable Instrument Job Type Codes describes the type of job being performed when the reading was taken.

Code	Meaning	Notes
0	N/A or Not Supported	
1	Routine Survey	
2	Hot Job	
3	Free Release	
4	Contamination	
5	Dose Rate	
6	Special	
7	Incident/Accident	
8	Other	
65435 – 65534	Generic, Instrument Manufacturer or User Defined	User or the Instrument manufacturer assigns the meaning to these codes.

Portable Instrument Slide Position Codes

Portable Instrument Slide Position Codes indicates the position of a window/slide or other means of blocking/filtering out data collection.

Code	Meaning	Notes
0	N/A or Not Supported	
1	Closed	
2	Open	

Portable Instrument Reading Type Codes

Portable Instrument Reading Type Code is used to indicate whether the reading has been corrected for any reason. The gross reading is total counts or a value based upon total counts/events. The net reading is a corrected reading. It is the responsibility of the instrument manufacture to specify the corrections applied to the gross reading to obtain the net reading. Such as: background subtraction (fixed or variable), crossover correction, temperature-based corrections, etc.

Code	Meaning	Notes
0	N/A or Not Supported	
1	Gross	
2	Net	
3	Crossover Correction	
4	Temperature Correction	

5	Fixed Background Subtraction	
6	Variable Background Subtractions	
7	Crossover, Fixed Background Subtraction	
8	Crossover, Variable Background Subtractions	
9	Crossover, Temperature Correction	
10	Crossover, Fixed Background Subtraction, Temperature Correction	
11	Crossover, Variable Background Subtractions, Temperature Correction	
12	Temperature Correction, Fixed Background Subtraction	
13	Temperature Correction, Variable Background Subtractions	
235-254	Compensated Reading, Instrument Manufacturer or User Defined	Contact Instrument Manufacturer to obtain meaning/definition

Portable Instrument Message Type Codes

Portable Instrument Message Type Codes describe the type of portable instrument message being pushed.

Code	Meaning	Notes
0	Measurement	
1	Spectrum Footer	
2	Spectrum Measurement Footer	
3	Status	

Portable Instrument Type Of Units Codes

Portable Instrument Type Of Units Codes is used to indicate what type of reading units that are being pushed. It is used to further define the type of units being used to take the reading.

Code	Meaning	Notes
0	N/A or Not Supported	
1	Rate	
2	Dose	

Portable Instrument Measurement Mode Type Codes

Portable Instrument Measurement Mode Type Codes are used to indicate the mode the instrument was in when the reading was taken.

Code	Meaning	Notes
0	N/A or Not Supported	

1	Ratemeter	
2	Integrate	
3	Scaler	
4	Peak Hold	
5	Background	
6	Pulse Height Analysis (PHA)	
7	Spectral Analysis	

Portable Instrument Probe Type Codes

Portable Instrument Probe Type Codes are used to indicate the type(s) of probe used to take the reading.

Code	Meaning	Notes
0	N/A or Not Supported	
1	Gas filled, energy proportional	
2	Scinitillator, energy proportional	
3	Geiger tube, energy proportional	
4	Geiger tube, non-energy compensated	
5	Ion Chamber (V-F converter)	
6	Pin Diode	

Portable Instrument Reliability Index Codes

Reliability Index Codes are used and support of ANSI 42.34 for Identifiers. More codes will be added after the ANSI standard is approved.

Code	Meaning	Notes
0	Not Used or N/A	Indicates that this option is not support by the instrument

Standard RadNet Header Codes

2/19/2004 8:16 PM

Authentication Status Codes

See the following pages for more information concerning RadNet Security Implementation:

Background Information
RadNet Security Implementation
Authentication
Encryption

These codes indicate whether a RadNet message has been authenticated (message fails signature verification). RadNet message(s) are directed to/at a RadNet Authentication Server (RAS) or other device. The RAS will authenticate the message and set byte 52 to indicate the status of the authentication process. The RAS server will then forward the message to clients on the network. It is important that the RAS server is secure and that the data leaving the RAS server is on a secure network (the message will not be tampered with after authenticated). It is also important to note that the RAS server does not strip the authentication keys from the message, and the authentication process could be done at any time, including storing the authentication signature within a database for future verification of the message.

The Authentication software/server will set this byte value to indicated message signature verification status.

Code	Meaning	Notes
0	Message is Ok	
>0	Message fails signature verification.	

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Channel Types

Below is a code for type of channel.

Code	Meaning	Notes
0	Alpha	
1	Beta	
2	Gamma	
3	Neutron	
4	Iodine	
5	Noble Gas	
6	Tritium	
7	Stack Flow	
8	Sample Flow	
9	Temperature	
10	Sample Pressure	
11	Leak rate	Primary to secondary, or containment building leak
12	Reactor power	Used for leak measurements
13	Beta + Gamma	The sum of the beta and gamma channels.
14	Latitude	
15	Longitude	
16	Altitude	
17	Humidity	
18	Wind Speed	
19	Wind Direction	
20	Alpha/Beta	
21	Pulse Height Analysis (PHA)	
22	Dust Particle	
23	Humidity	
24	Anemometer	

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Monitor Type Codes

Bytes (54-55) are code for the instrument type.

Code	Meaning	Notes
0	Gamma Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
1	Gamma Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
2	Neutron Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
3	Neutron Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
4	Alpha CAM	Uses the Alpha CAM body, Measurement Footer, Spectrum Footer. See Alpha CAM Header, Body, Measurement Footer, Spectrum Footer and Notes for more information.
5	Beta CAM	Uses the Beta Cam body and footer format. See Beta CAM Header, Body, Footer and Notes for more information.
6	PCM Monitor	Uses the PCM body and footer format. See PCM Header, Body, Footer and Notes for more information.
7	PCM Portal Monitor	Uses the PCM Body and Footer format. See Portal Header, Body, Footer and Notes for more information.
8	PING	Uses the PING Body and Footer format. See PING Header, Body, Footer and Notes for more information.
9	Glove Box Monitor/Hand Monitor	Uses The PCM Body and Footer format. See PCM Header, Body, Footer and Notes for more information.

Standard RadNet Header Codes

2/19/2004 8:16 PM

10	Hand And Foot Monitor	Uses The PCM Body and Footer format. See Hand and Foot Header, Body, Footer and Notes for more information.
11	Generic Sensor	Uses The Generic Sensor Body and Footer format. See Generic Sensor Header, Body, Footer and Notes for more information.
12	Electronic Reading Dissymmetry	See Header, ERD Body, ERD Footer, for more information.
13	Item Contamination Monitor (ICM)	Uses The ICM Body and Footer format. See Header, Body, Footer and Notes for more information.
14	Radiation Gateway Monitor	Uses The Radiation Gateway Body and Footer format. See Header, Body, Footer and Notes for more information.
15	Gamma Spectrum	Uses The Gamma Spectrum Body, Measurement, Spectrum, Status and Footer format. See Header, Body, Measurement, Spectrum, Status and Notes for more information.
16	Portable Instruments	Protocol Pending, in development by vendor
17	Meteorology Tower	Uses The Meteorology Tower Body and Footer format. See Header, Body, Measurement, Status, and Notes for more information.
18	Video	Uses The Video Body, Status and Footer format. See Header, Body, Footer, Status and Notes for more information.
19	Image	Protocol Pending, in development by vendor
20	Audio	Protocol Pending, in development by vendor
21	Security data tag/seal	Protocol Pending, in development by vendor
22	Tritium Air Monitor	Protocol Pending, in development by vendor
23	Dust Particle Monitor	Protocol Pending, in development by vendor

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Message Codes

Byte (03) is the message code. The message code indicates what type of RadNet message has been sent (status, check source, etc.).

Code	Meaning	Notes
0	Normal/Standard RadNet Message	Message is pushed by the instrument and received by the clients.
1	Alarm Ack	Message is pushed by the clients and received by the instruments. See Alarm Acknowledge Alarm Msg. Notes and Alarm Acknowledge Header Format
2	Pass Through	Message is pushed by the instrument and received by the client or can be pushed by the client and received by the instrument. This method can be used for bi-directional communication by the clients and instruments. See Pass Through Msg. Header Notes / Pass Through Header Format or Pass Through Codes
3	Check Source	Message is pushed by the clients and received by the instruments. See Check Source Msg. Notes and Check Source Header Format
4	Diagnostic/Self-Check	Message is pushed by the clients and received by the instruments. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
5	Request Data	A client/server sends this request to an instrument. In response to this request the instrument will send its current information (Normal RadNet Message). See Request Data Notes and Request Data Header Format
6	Update/Request Date/Time	A client/server sends this request to an instrument. In response to this request the instrument will send/set the date/time. See Update/Request Date/Time Notes and Update/Request Date/Time Header Format
7	Acknowledge Receipt	This message is used by the monitoring computer to acknowledge receipt of data from an instrument. See Acknowledge Receipt Message Header Format and Acknowledge Receipt Message Notes for more information.
255 (FFh)	Encrypted RadNet Message	See the following pages for more information: Background Information RadNet Implementation Encryption Header Message Format

Standard RadNet Header Codes

2/19/2004 8:16 PM

		Encryption Background Information

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Operational and Hardware Status Codes

Note: It is the responsibility of the instrument manufacturer to prioritize the operational and hardware status for the instrument. Any status code can be used either as an operational or hardware status code base upon the instrument usage or needs.

Below is a code used to display the Hardware/Operational Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions may be attributed to either hardware or operational problems. Instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage and low background, the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as an HV power supply failure.

OP = Guide For Operational Status Use
HW = Guide For Hardware Status Use

Code	Meaning	OP	HW	Notes
0	Normal	Y	Y	
1	High Alarm	Y	N	
2	HV Fail	N	Y	
3	Count Fail	Y	N	
4	Bkg Fail	Y	N	
5	Bkg Update	Y	N	
6	Comm Fail	N	Y	
7	Gas Empty	Y	N	
8	Buffer Full	Y	Y	
9	Acked High Alarm	Y	N	
10	Flow Fail Low	Y	Y	
11	Flow Fail High	Y	Y	
12	Filter Door Open	Y	N	
13	Instrument Not Ready	Y	Y	
14	Instrument In Calibration Mode	Y	Y	
15	Fast Concentration Alarm	Y	N	
16	Slow Concentration Alarm	Y	N	
17	DAC Hours Alarm	Y	N	
18	Count Rate Alarm	Y	Y	
19	Release Rate Alarm	Y	N	

20	Fast Concentration Alarm Disabled	Y	N	
21	Slow Concentration Alarm Disabled	Y	N	
22	Count Rate Alarm Disabled	Y	N	
23	Check Source Mode	Y	N	
24	Out Of Service	Y	Y	
25	Alert Alarm	Y	N	
26	Trend Alarm	Y	N	
27	Not Initialized	Y	Y	
28	Standby	Y	Y	
29	Local Control	Y	Y	
30	Flush	Y	N	
31	Alarm Disabled	Y	N	
32	External Fail	Y	Y	
33	AC Off	Y	Y	
34	Crit Relay Fail	Y	Y	
35	Out Of Limits	Y	Y	
36	Crit Alarm	Y	N	
37	NV RAM Fail	N	Y	When the instrument's non-volatile RAM cannot be read/written.
38	Check Source Results	N	Y	Indicates that the message with this status carries check source results. This indicates that this message contains the final check source result at the completion of the check source integration. Prior to this code being sent the status code would be 23 (*Check Source Mode*).
39	Audio Failure	N	Y	Indicates that the instrument has a problem with its audio circuit.
40	Over Range	Y	Y	Indicates that the instrument has exceeded an Over Range value.
41	Diagnostic/Self-check completed, Passed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found no error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format

42	Diagnostic/Self-check completed, Failed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
43	High/High Alarm	Y	N	Third alarm level used in many plants.
44	Internal stabilization failure	Y	N	From automatic energy stabilization.
45	Parameter error	Y	N	Bad setup.
46	Temperature failure	N	Y	Temperature out of operational range.
47	Power supply failure	N	Y	From power supply, or from voltage reading.
48	Analog input failure	N	Y	4-20 mA analog input failure (0 mA for example).
49	Filter failure	N	Y	Automatic filter advance failure (motor, end of roll…).
50	Detector cable failure	N	Y	
51	Electronic or Acquisition board failure	N	Y	Electronic failure.
52	Low Battery	N	Y	Backup battery or internal battery has a low voltage condition.
53	Battery Failed	N	Y	Backup battery or internal battery has failed.
54	Clock Failed	N	Y	Internal clock has failed.
55	User defined	Y	Y	This error code is used whenever an instrument supports user defined error codes. It is used whenever there is a desire to inform a user that one of their error conditions has been reached. Since there is no way of knowing what is contained in the error code logic, this generic response should be used to indicate the error.
56	Internal Communication Failure	N	Y	

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Versions

Note: The last approved version in this list is the current version in use by RadNet.

The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of RadNet be pushed by the server. It is the responsibility of the receiving software to handle all received RadNet messages, although the most current version's functionality may not be provided.

Version	Date Approved	Notes
0	Approved	

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Units Codes

Below is a code for the RadNet units of the reading.

Code	Meaning	Notes
0	cps	
1	Rem/hr	
2	R/hr	
3	Sv/hr	
4	Bq/cm3	
5	Bq	
6	Degrees Centigrade (C)	Temperature Unit
7	Pascal (Pa)	Pressure Unit
8	cc	Flow Volume Unit
9	cc/sec	Flow Rate Unit
10	cps/cc	Activity Unit
11	counts	Counting Events Unit
12	cm/sec	Velocity Unit
13	bqMeV/cc	Gamma Gas Activity
14	degrees	Wind Direction (180 = south)
15	Gy/hr	Dose Rate Unit
16	RPU%	Reactor Power Unit
17	Kg/sec	Masse flow rate
18	n/cm2	Neutrons / cm2
19	n/cm3	Neutrons / cm3
20	DAC	Derived Air Concentration
21	bq/m3	Becquerel per cubic meter
22	bq/kg	Becquerel per kilogram
23	Latitude	
24	Longitude	
25	Mu_Hemin	Hemisphere North
26	Mu_Hemis	Hemisphere South
27	Mu_Hemie	Hemisphere East
28	Mu_Hemiw	Hemisphere West
29	Mu_Knots	Wind Speed (knots)
30	Mu_KPH	Wind Speed (knots per hour)
31	Mu_MPS	Wind Speed (meters per second)
32	Mu_MPH	Wind Speed (meters per hour)

Standard RadNet Header Codes

2/19/2004 8:16 PM

33	Mu_METERS	Altitude (meters)
34	Mu_Feet	Altitude (feet)
35	Mu_Percent	Humidity
36	Resistance	Electrical Resistance
37	µm	Micro-meter

Standard RadNet Header Codes

2/19/2004 8:16 PM

RadNet Server Status Codes

Byte (7) is a code that displays the status of the server. Codes are provided for normal as well as a variety of abnormal conditions. See Appendix A for Server Status message codes.

Code	Meaning	Notes
0	Normal Operation	
1	Instrument Communication Error	
2	TCP Communication Error	
3	UDP Communication Error	
4	Hard Disk Full	
5	Password Fail	
6	Starting Up	
7	Shutting Down	
8	Program Error	
9	NetWork Access Granted	
10	NetWork Access Denied	

Standard RadNet Header Codes

2/19/2004 8:16 PM